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The extensive network of public lands west of the St. Francois County, Missouri, area guided and limited route development. Conceptual Routes through this area were forced to either: 1) follow along a northern trajectory, ultimately turning south once west of the Potosi Ranger District of the Mark Twain National Forest; or 2) follow a path from the southwest after weaving through the patchwork of state parks and National Forest System lands (between the Salem and Fredericktown Ranger Districts) forming the Heart of the Ozarks recreational attractions.

While the extensive network of public lands in the area limited route development opportunities in many places, it also had a compounding effect of concentrating route development to the areas in between the public lands. This effect was encountered throughout the Ozarks region, most notably in the area immediately adjacent to the St. Francois Substation. In this area, several large state parks (the St. Joe and St. Francois State Parks) and a dense stretch of intervening development (Farmington, Leadington, Park Hills, Deslodge, and Bonne Terre) served as major constraints to identifying suitable routes into the St. Francois area.

Conceptual Routes east of the St. Francois area were largely guided by the identification of suitable Mississippi River crossing locations. The Routing Team focused on the area south of St. Louis and north of the Shawnee National Forest that occupies the east shore of the river from Grand Tower, Illinois, to roughly the Kentucky border. Few existing utility crossings of the river were found in this area, and extensive development extending south of St. Louis combined with large federal and state conservation areas—largely associated with the Mark Twain National Wildlife Complex—made many crossing locations unsuitable. The Routing Team considered crossings near Barnhart, along the northern edge of the Mark Twain National Wildlife Refuge; north of the Rush Island Power Plant adjacent to the recently constructed 345 kV line crossing; near Chester, Illinois, at the crossing of Missouri State Route 51; and farther south near Grand Tower, Illinois. Each of these crossings was either highly encumbered by nearby development (Barnhart and Chester crossings) or a combination of state and federal conservation lands (the Shawnee National Forest lands near Grand Tower and the Mark Twain National Wildlife Refuge Complex near Rush Island).

In Illinois, the network of Conceptual Routes south of St. Louis continued east and northeast toward the eastern converter station, generally east of the suburbs of St. Louis and Carlyle Lake. Three major Conceptual Routes were developed from the Mississippi River crossing to the Sullivan Substation, with additional route links developed to connect sections of the three Conceptual Routes or to avoid highly constrained areas. Two of these major Conceptual Routes followed a series of existing transmission lines across the state. The first route followed the existing 345 kV lines from Rush Island to Baldwin, West Mt. Vernon, Louisville, Newton, Casey, and into the Sullivan Substation. The second route followed a more southerly path along a mixture of 345 kV and 138 kV lines from Grand Tower to West Frankfort, Norris City, Albion, Olney, Lawrenceville, Hutsonville, and into the Sullivan Substation in Indiana. The

third Conceptual Route followed a pipeline from southwest of Steelville, Illinois, and continued northeast past Oakdale, Nashville, and Centralia before turning east at Kinmundy and joining the first Conceptual Route near Louisville, Illinois.

In general, the density of residential and commercial development in Illinois was highest near East St. Louis, in the suburbs extending east of the city toward Belleville, and along the I-70 and U.S. Highway 40 corridor.³ Residential development near Centralia, Mt. Vernon, and West Frankfort also encumbered route development, forcing the development of several new routes that only loosely parallel existing infrastructure or section/ parcel boundaries. Overall, residential density was highest in Illinois in the central and southern portions of the Study Area and lowest in the northern portion of the Study Area. Significant state and federal land ownership and conservation easements along the Mississippi River south of St. Louis, steep bluffs particularly on the Missouri side of the river, as well as residential development along the I-55 corridor led to challenges in identifying suitable river crossing locations.

4.2.4 Comparison of Conceptual Routes in the Study Area

Once the network of Conceptual Routes for the entire Study Area was developed, the Routing Team conducted a comparative review of the Conceptual Routes. The analysis considered the likelihood for potential impacts from the Project through comparisons of key environmental, land use, and engineering factors for a given route or route segment.

Initially, comparisons were conducted at the individual Conceptual Route or route segment level to eliminate routes that were likely not suitable as a result of new insight derived from ongoing public and agency coordination efforts, newly acquired data sources, or route reconnaissance efforts. Similar to a fatal flaws analysis, this effort removed those Conceptual Routes that were not likely to reasonably meet the routing guidelines, or simply resulted in likely impacts that were inconsistent with the majority of other routes considered. Several of these removals were referenced in the preceding sections.

The Routing Team then compared the overall feasibility of siting the Project in either the northern, central, or southern portion of the Study Area based on major differences between groups of Conceptual Routes in each portion. These analyses identified the broad scale challenges and limitations of each portion of the Study Area and ultimately led to the selection of the portion of the Study Area that the Routing Team would continue to pursue by developing Potential Routes.

³ Like the remnants of Historic Route 66 found along I-40 in Missouri, historic features of the Historic “National Road” created in 1806 by legislation signed by President Thomas Jefferson are found along the I-70/U.S. 40 corridor. This corridor is listed as a National Scenic Byway by the U.S. Department of Transportation, Federal Highway Administration.

Residential density was one of the most notable differences between the northern, central, and southern portions of the Study Area. Given the importance of avoiding residences in the siting process, residential density was a key factor in the comparison. During the development of Conceptual Routes, the Routing Team recognized significant differences in the density of residential development among the northern, central, and southern areas and its effect on developing reasonable alignments along existing transmission lines and pipelines and allowing for relatively straight alignments along section/parcel boundaries.

At the four-state scale, digitizing individual residences was not practical, so the Routing Team used census information to provide numerical evidence to support the challenges it observed during development of the Conceptual Routes. The 2010 census data include an estimate of the number of residences within each census block, allowing the Routing Team to derive a residential density (residences/square mile). The results of this analysis, with an overlay of the three generalized portions of the Study Area, are presented in **Figure 4-5**. To provide the color categorization for the density ranges, the Routing Team evaluated the difficulty of developing routes in areas with varying numbers of residences per square mile. This was accomplished by sampling Public Land Survey System sections (each roughly 1 square mile) throughout the Study Area, assessing the overall difficulty of routing a transmission line through each section, and then counting the number of houses to derive a residential density.

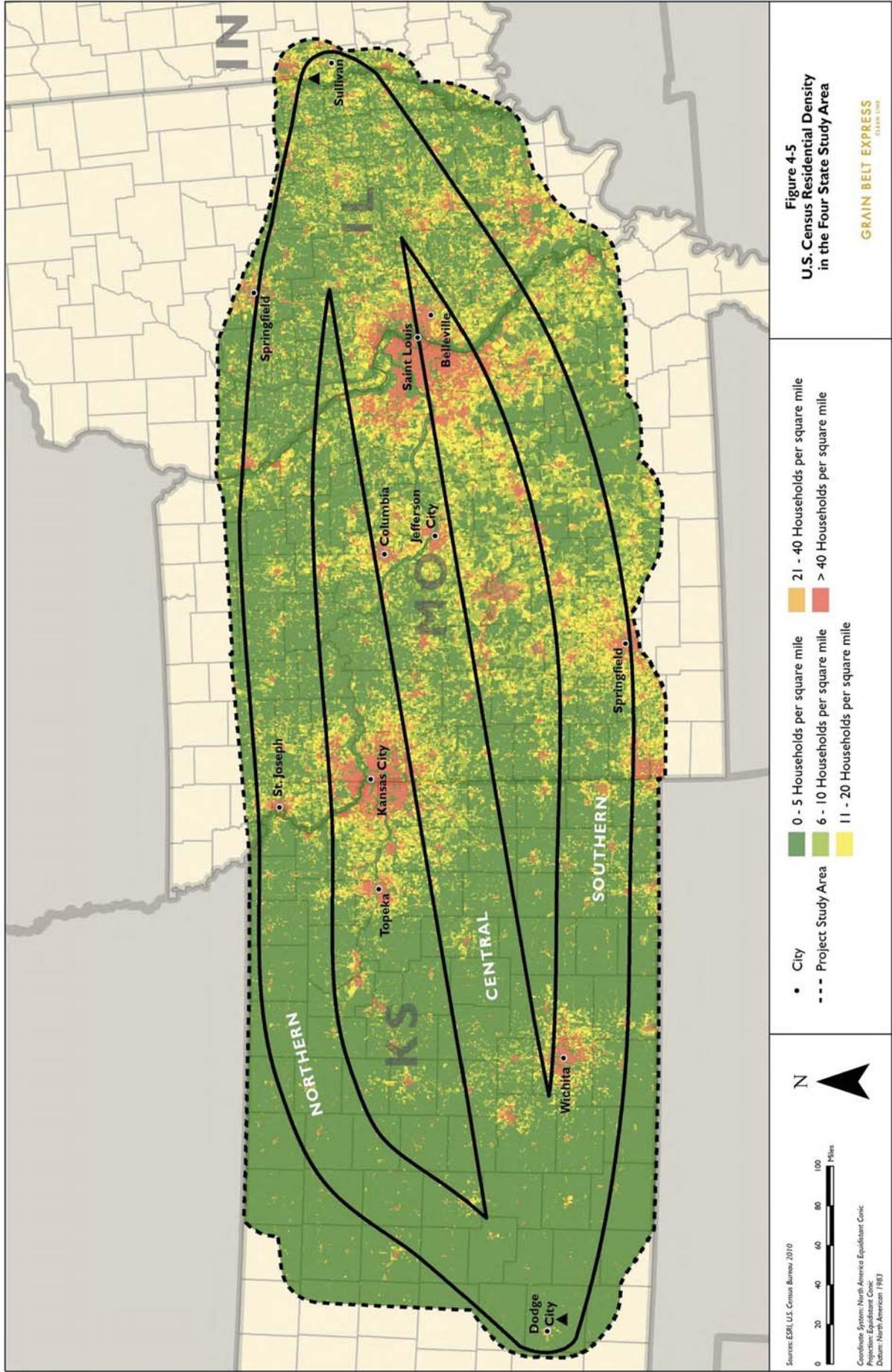
As shown on **Figure 4-5**, the Conceptual Routes through the central portion of the Study Area in Missouri, although generally shorter, would affect areas with significantly greater residential density. Areas of higher residential density begin south of Kansas City and continue to Sedalia, Columbia, Jefferson City, St. Peters, and the metropolitan area north of St. Louis. Moreover, where low residential density areas appear in the central portion of the Study Area south of Kansas City, reservoirs and conservation areas occupy key areas. In addition to high residential densities, the Conceptual Routes in the central portion of the Study Area also had fewer miles parallel to existing transmission lines or pipelines; fewer suitable crossings of the Missouri River that did not impact either federal, state, or private conservation lands; and no suitable locations for crossing the Mississippi River without diverting north to reach crossings in the northern portion of the Study Area—all of these increased the overall length of the route. For these reasons, the Routing Team removed the Conceptual Routes in the central portion of the Study Area from further consideration and did not hold Roundtables in those areas.

Conceptual Routes in the southern portion of the Study Area also had higher residential densities in Missouri and Illinois than in the northern portion of the Study Area in those two states. Residential density north of Springfield, Missouri, along I-44 (Lebanon and Rolla), and into the St. Francois Substation near Farmington made Conceptual Route development difficult. In addition, the extensive and irregular sprawl of the Harry S. Truman, Lake of the Ozarks, Pomme De Terre, and Stockton Lake reservoirs significantly limited the potential for reasonable alignments. The presence of the Mark Twain National Forest, Shawnee National

Forest, U.S. Army's Fort Leonard Wood, National Park Service's Ozark National Scenic Riverway, and extensive state and private conservation lands in the southern portion of the Study Area further constrained the development of reasonable Conceptual Routes. Discussion with MDC and USFWS revealed the southern portion of the Study Area to be least suited for Conceptual Route development because of the amount of land already protected for sensitive species and habitats.

Despite these notable challenges in the southern portion of the Study Area, the Routing Team considered the southern portion more reasonable than the central portion of the Study Area and held a series of Roundtables in southern Illinois to add to data gathered at Roundtables held in southern Kansas and Missouri. However, additional routing challenges were identified during meetings with community leaders and regulatory agency representatives in Illinois, and based on further review and consideration of the few suitable Mississippi River crossings south of St. Louis and challenges discussed above in approaching the river from both directions, the Conceptual Routes in the southern portion of the Study Area were also removed from further consideration.

Ultimately, the Routing Team considered the Conceptual Routes in the northern portion of the Study Area to be the most suitable for the Project, and the Routing Team focused its route development efforts there. As shown on **Figure 4-5**, Conceptual Routes through the northern portion of the Study Area fall largely within areas with low overall residential density for the majority of the route. In addition, although public lands and reservoirs are common in the northern portion of the Study Area, they tend to be smaller and more dispersed, preventing the concentration of residential development in the lands between them, and generally providing multiple routing options to consider through an area. At the same time, sensitive habitats are generally limited in northern Missouri and Illinois, and those that are present are either largely avoidable or would result in impacts that could be minimized or mitigated. Lastly, an array of opportunity features of different types are available for the development and refinement of Potential Routes, and multiple suitable river crossing locations were identified for each of the major river crossings.



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4.3 Potential Routes

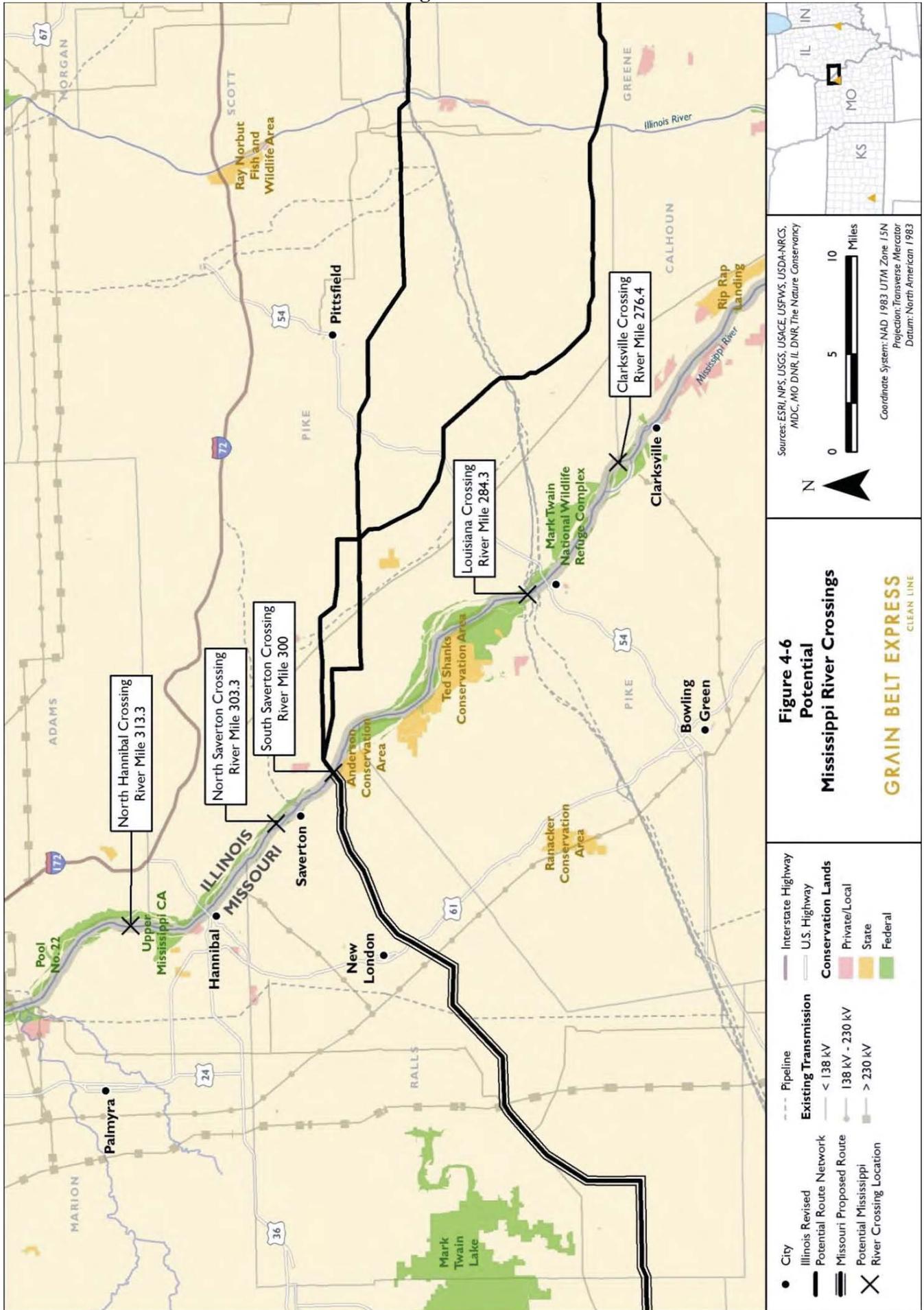
Once the Routing Team focused on the northern portion of the Study Area, the Study Area was effectively reduced for the continued siting activities for the Project and additional route revisions.

Because of the multi-state nature of the Project, Alternative Routes were developed and analyzed in Kansas first to determine the Proposed Route (detailed in the Kansas Route Selection Study, 2013). Once the Kansas Proposed Route was selected, Potential Routes in Missouri were refined based on the known location of the Missouri River crossing (detailed in the Missouri Route Selection Study, 2014). The Missouri Route Selection Study, in turn, included the analysis conducted to identify the Mississippi River crossing location, and the starting point of the Potential Routes in Illinois. The results of the Mississippi River crossing analysis and the development of Potential Routes in Illinois are described below.

4.3.1 Identification of the Mississippi River Crossing Location

Many Mississippi River crossings were considered during the Conceptual Route phase. Initial siting efforts focused on locations along the river with existing infrastructure crossings. However, those few sites that were identified with existing infrastructure crossings were either encumbered by residential and commercial development, existing infrastructure, sensitive cultural and recreational resources, or environmentally sensitive federal lands. Thus, the Routing Team also considered an array of crossing locations where no existing infrastructure currently crosses the river. For these crossings, the team considered a variety of factors, including (but not limited to): potential for impacts on public land resources, existing irrigation infrastructure, sensitive species habitats, historic resources, as well as the technical design requirements of the crossing itself.

Many potential Mississippi River crossings were considered throughout the routing process. Those that were removed from consideration early in the process were typically: connected to Conceptual Routes that were later removed from consideration (see Section 4.2.4, *Comparison of Conceptual Routes in the Study Area*); did not meet reasonable engineering requirements (reasonable span lengths or geotechnical concerns); or were connected to routes that would result in unreasonable impacts. The Routing Team focused on five from which the preferred crossing location was ultimately selected (**Figure 4-6**). The northernmost crossing was near Hannibal, Missouri, while the southernmost was just north of Clarksville, Missouri. Several agency meetings were held with Missouri Department of Natural Resources (MDNR), MDC, USFWS, USACE (Rock Island and St. Louis Districts), IDNR, and Missouri State Historic Preservation Office to discuss each river crossing and receive feedback for incorporation into the final decision. A brief description of each river crossing along with the feedback received from the agencies is discussed below.



Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, MDC, MO DNR, IL DNR, The Nature Conservancy

Coordinate System: NAD 1983 UTM Zone 15N
 Projection: Transverse Mercator
 Datum: North American 1983

0 5 10 Miles

Figure 4-6
Potential
Mississippi River Crossings

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 CLEAN LINE

- City
- Illinois Revised Potential Route Network
- Missouri Proposed Route
- Potential Mississippi River Crossing Location
- Pipeline
- Existing Transmission
 - < 138 kV
 - 138 kV - 230 kV
 - > 230 kV
- Interstate Highway
- U.S. Highway
- Conservation Lands
 - Private/Local
 - State
 - Federal

1. *Northern Hannibal Crossing (River Miles 313–314):*⁴ The northernmost river crossing is located approximately 3.5 miles north of Hannibal, Missouri. This location crosses approximately 14,300 feet of floodplain on the Missouri side before crossing the Mississippi River with an approximate span (from bank to bank) of 5,800 feet. On the Illinois side, the Potential Route crosses approximately 16,150 feet of floodplain. The Potential Route crosses McDonald and Schaffer Islands, both of which are administered by USACE, Rock Island District. Land use on either side of the river within the floodplain is agricultural with few residences located near the Potential Route. Outside the floodplain, the topography increases with steep slopes and varying terrain.

The agencies identified several potential concerns with this crossing. USFWS raised an increased concern for the Indiana bat (a federally listed endangered species) along all of the northern river crossings (including this crossing and the two crossings north and south of Saverton). Forested lands along the northern crossings have a higher potential occurrence for both winter hibernacula and summer maternity colony presence. In addition, USACE, Rock Island District, noted its ownership of the two islands and stated that these areas are leased to USFWS and the State of Illinois. USACE also noted that crossing Pool 22 may be incompatible with its current designated use as a Natural Area.

2. *North Saverton (River Miles 303–304):* A second potential river crossing approximately 1 mile north of Saverton was considered. This crossing includes steep slopes and topography in a densely forested area on the Missouri side, but does not include any floodplain area outside of the edge of the river. The approximate span length across the river is 4,000 feet. On the Illinois side, the route crosses approximately 26,450 feet of floodplain. Landownership on the Missouri side of the river is private and the route crosses Camp Oko-Tipi, a non-profit youth camp. USACE, Rock Island District, administers land on the Illinois side of the river and the route crosses an unnamed island. This Potential Route is approximately 2 miles north of the Saverton Lock and Dam, a National Register Historic District (also known as Lock and Dam No. 22). USFWS noted the pool, which forms at the head of the Saverton Lock and Dam, is used by wintering and migratory waterfowl. USACE, Rock Island District, stated that the land administered by USACE is leased to USFWS and the State of Illinois. In this area, the land use designation is Wildlife Management/Reserve Forest, and USACE maintains the timber rights. USFWS also stated that like the northernmost crossing, this Potential Route may have a higher potential occurrence of both Indiana bat winter hibernacula and summer roosting habitats. In addition, several archaeological sites have been

⁴ Mileage is measured from the intersection of the Ohio and Mississippi Rivers near Cairo, Illinois (USACE 2015a).

previously identified on the Missouri side of the river and will require further investigation.

3. *South Saverton (River Miles 299–300)*: The third crossing is approximately 2.5 miles south of the Town of Saverton. Like the North Saverton crossing, this Potential Route goes from steep topography with dense forest cover to crossing 500 feet of floodplain and the Mississippi River. The Potential Route has an approximate span of 3,370 feet across the river and crosses approximately 36,750 feet of floodplain on the Illinois side. Land ownership on both sides of the river is private; however, the Anderson Conservation Area owned by MDC is located just south of the crossing on the Missouri side of the river. The route also crosses land on the Missouri side of the river owned by Knox County Stone Company, which has an active quarry located just north of the route. A structure will be required on Jim Young Island, which would reduce both the overall span length between structures and their required height.

USACE, St. Louis District, has jurisdiction over this river crossing (and all crossings farther south), although the Rock Island District maintains jurisdiction over the land on the Illinois side of the river (Sny Island Levee District). USACE, St. Louis District, stated a preference for this crossing location. Similar to the two crossings discussed previously, USFWS noted a higher potential occurrence of both winter hibernacula and summer roosting habitat. In addition, the Saverton Lock and Dam is located approximately 1.5 miles north of the crossing location, and USFWS noted this as a concern for potential impacts to bald eagles. In particular, the USFWS noted concerns related to potential avian collision issues with the transmission line. Due to these potential impacts to bald eagles in the area south of Saverton Lock and Dam, USFWS requested that a crossing north of the Lock and Dam be selected. The crossing location in this area has some flexibility and will require additional engineering prior to determining the exact location. Known archaeological sites on the bluffs of the Missouri side may impact crossing at this location.

4. *Louisiana (River Miles 284–285)*: This river crossing, located approximately 1.25 miles north of the Town of Louisiana, Missouri, is the only crossing that paralleled an existing linear feature across the river (a gas pipeline). The Potential Route crosses very little floodplain on the Missouri side and transitions from steep slopes down to the river. The Potential Route crosses the southern edge of Blackburn Island, parallel to the existing gas pipeline. Once on the Illinois side of the river, the Potential Route crosses 28,000 feet of floodplain. The total span across the river at this location is 3,200 feet. Structures will be placed on Blackburn Island, which would reduce the span length between structures crossing the river and decrease their required height.

Both USFWS and MDC stated this particular location is known for the presence of bald eagles as well as numerous migratory birds, and USFWS expressed concern about potential avian impacts. In addition, USACE, St. Louis District, and MDC discouraged the use of this crossing because of public land associated with the Ted Shanks Conservation Area on Blackburn Island. The conservation area is undergoing a large-scale environmental restoration project for forests and wetlands, and further impacts on the island are discouraged. It was also noted that bald eagles, herons, and egrets are known to nest on the island. Although this Potential Route parallels an existing gas pipeline, USACE noted that impacts from the transmission line may be greater because permanent vegetation clearing would be required to maintain appropriate electrical clearances.

The Town of Louisiana is the most densely populated area of the five crossings and contains a historic downtown that is included in the National Register. In addition to the above considerations, the Missouri Department of Transportation is evaluating whether to rebuild the bridge at Louisiana in its current location or re-locate the bridge. Therefore, potential conflicts may arise if the bridge is relocated close to the Potential Route crossing.

5. *Clarksville (River Miles 276–277)*: The final river crossing that was presented at the Public Meetings is approximately 3 miles north of Clarksville. The topography is steep and rapidly transitions to the river without crossing floodplain area on the Missouri side. The Potential Route crosses over Pharrs Island before reaching the Illinois side of the river and crossing 24,950 feet of floodplain. The crossing in this location spans approximately 7,950 feet of the river and will require a structure(s) on Pharrs Island to decrease the overall span length between structures and their height. Pharrs Island is surrounded by a bullnose that was constructed to increase habitat for waterfowl and fisheries. The island includes suitable habitat for bald eagle nesting and roosting, as well as Indiana bat habitat. It also provides recreational uses for waterfowl hunting, with numerous blinds scattered on the island. In addition to Pharrs Island, a state wildlife management area just south of the crossing location is managed for waterfowl and other migratory birds. Additionally, numerous cultural sites have been identified along this stretch of the Mississippi River and the Missouri SHPO believes more sites may exist along the bluffs on the Missouri side.

Once all the information was reviewed, the preferred river crossing location was determined to be the South Saverton crossing between river miles 299 and 300 (**Figure 4-7**). This crossing location was preferred by USACE, St. Louis District, and had the fewest conflicts associated with current land use of any the crossings. Although USFWS considered this crossing less desirable due to potential for bald eagle impacts, residential development in this location is low with a quarry bordering the north side of the route and the Anderson

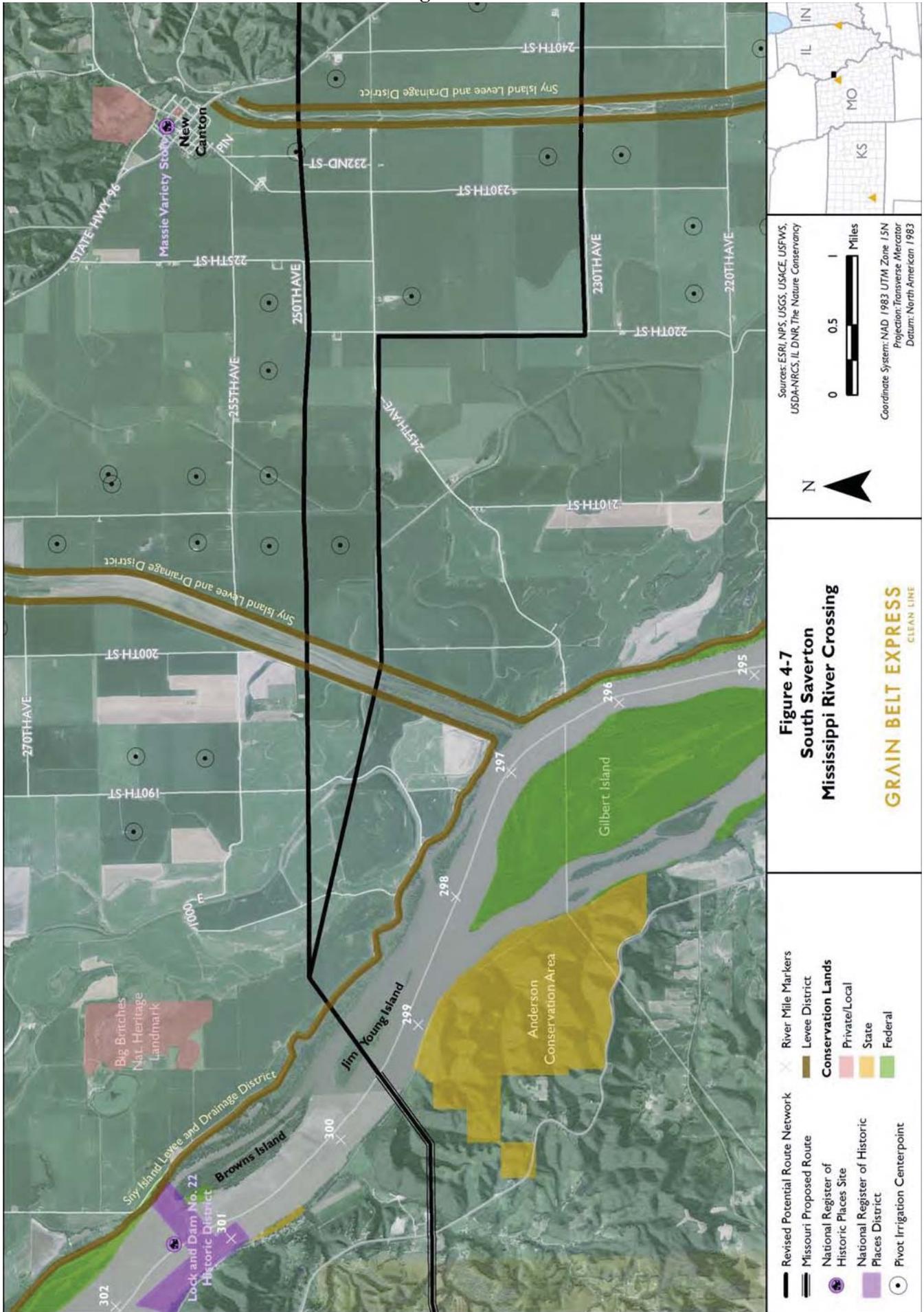


Figure 4-7
South Saverton
Mississippi River Crossing
GRAIN BELT EXPRESS
CLEAN LINE

- Revised Potential Route Network
- Missouri Proposed Route
- National Register of Historic Places Site
- National Register of Historic Places District
- Pivot Irrigation Centerpoint
- River Mile Markers
- Levee District
- Conservation Lands
 - Private/Local
 - State
 - Federal

Sources: ESRI, NPS, USGS, USACE, USFWS, USDA-NRCS, IL DNR, The Nature Conservancy

Coordinate System: NAD 1983 UTM Zone 15N
Projection: Transverse Mercator
Datum: North American 1983

0 0.5 1 Miles

Conservation Area on the south side. From an engineering perspective, the South Saverton crossing offers flexibility in the exact alignment across the river and will allow a structure to be placed on Jim Young Island to reduce span length and structure height. In addition, this crossing is located south of the Saverton Lock and Dam where the river is narrower, which also will help reduce structure height. Collision with the transmission line may be considered a potential risk for bald eagles as well as other avian species at waterbody crossings such as at the Mississippi River. To plan for and mitigate these concerns, Grain Belt Express will implement an Avian Protection Plan in accordance with the Avian Power Line Interaction Committee guidance to minimize any potential impacts to avian resources.

4.3.2 Development of the Potential Route Network

The identification of the Mississippi River crossing location focused further route network refinements and revisions on the Potential Routes emanating from the crossing point south of Lock and Dam 22. During the summer of 2014, the Routing Team reviewed information gathered at the Roundtables, conducted additional route reconnaissance, gathered input from regulatory agencies, and conducted comparative reviews of route segments with similar starting points and endpoints, as part of the route network refinement process.

By November 2014, the Routing Team identified the Potential Route Network suitable for presentation to the general public at Public Meetings in Illinois (**Figure 4-8**). The Potential Route Network consisted of 74 interconnected route segments, extending from the Mississippi River to the Wabash River.

As discussed in Section 3.3.2, the Routing Team presented the Potential Route Network at the December 2014 and February 2015 Public Meetings. At the meetings, members of the Routing Team assisted attendees in locating their property or other features of concern on aerial photography maps showing the array of Potential Routes under consideration. Participants were provided pens and markers and were encouraged to document the location of their houses, places of business, properties of concern, or other sensitive resources on the printed maps. After the Public Meetings, all of the maps were scanned, geo-referenced, and integrated into the GIS database, and comments received via comment card were correlated with landowner addresses.

4.3.3 Revisions to the Potential Route Network

Revisions were made to the Potential Routes following Public Meetings in Illinois to respond to comments that were relevant to routing, consider new information from route reconnaissance and agency coordination, and as a result of ongoing reviews of engineering challenges and solutions. Most of these revisions were relatively small (resulting in the adjustment of Potential Routes by approximately 50 feet to about 200 feet); however, several were larger in scale (changes on the order of miles) and warrant specific discussion (see **Figure 4-9**). The majority of revisions involved modifying the routes to be aligned along true ownership boundaries rather than along parcel lines between tracts owned by the same owner, and to be farther away from residences.

1. *Mississippi River Floodplain:*

The Mississippi River floodplain is dominated by large parcel farms, flood control infrastructure (levees and drainage ways), wetland complexes, pivot irrigation, and sporadic residences. The Routing Team initially identified several Potential Route alignments along parcel boundaries and the existing Ameren 115 kV transmission line through this area, while still minimizing impacts on pivot irrigation and residences.

Following the second round of Public Meetings, one of the existing Potential Routes was revised to take into consideration new information concerning center pivot irrigation operations, farming practices, and landowner input. The revised Potential Route largely followed parcel boundaries east of the channelized Hadley Creek drainage, south along 220th Street, and east along 230th Avenue, continuing along parcel boundaries east of the Kiser Creek drainage way. The route crosses the Ameren 115 kV line and continues due east into the bluffs to connect with the Potential Route Network just northwest of the intersection of 290th Street and 225th Avenue. This route revision was developed in coordination with the landowners in the floodplain to reduce the amount of farms that would be split by the original alignment through this area. The revisions also reduced the total route length of this route within the floodplain.

2. *Pike County, southwest of El Dara:*

The Potential Routes southwest of El Dara presented during the first and second round of Public Meetings paralleled a 138 kV transmission line for 1.8 miles before angling to the southeast. The Potential Routes were revised for a 2.7-mile stretch to continue due east from the parallel segment for 1.5 miles before turning south to follow parcel boundaries for 1.2 miles. This revision was made to avoid potential sensitive cultural resources and minimize the fragmentation of the contiguous forest along the bluffs at this location.